

WE CLAIM:

1. In a method of operating a hemodialysis machine, an improvement in a man/machine interfacing process used in changing a treatment parameter, the improvement comprising:
- providing a touch screen interface with an indicia thereon corresponding to a treatment parameter;
 - touching the indicia;
 - in response to said touching, invoking a new keypad display on a region of the touch screen;
 - entering a numeric parameter corresponding to the treatment parameter by touching one or more buttons of the displayed keypad;
 - touching a first region of the keypad to signal end of entry of the numeric parameter;
 - displaying on the touch screen a button soliciting verification of the newly entered numeric parameter;
 - touching the button soliciting verification; and
 - in response to said actions, causing the treatment parameter to be changed;
 - wherein erroneous changes of treatment parameters are minimized.
2. The method of claim 1 which further includes removing the button soliciting verification from the screen if it is not touched within a predetermined period, said predetermined period being less than fifteen seconds.
3. The method of claim 1 which further includes: establishing upper and lower limits for the parameter; and displaying said limits on the screen when the keypad display is invoked to change the parameter, said limits being displayed at the location on the screen where the indicia corresponding to said parameter was displayed prior to the touching of said indicia.

- 25 2. The method of claim 1 which further includes removing the button soliciting verification from the screen if it is not touched within a predetermined period, said predetermined period being less than fifteen seconds.

- 30 3. The method of claim 1 which further includes:
establishing upper and lower limits for the
parameter; and
displaying said limits on the screen when the
keypad display is invoked to change the parameter, said
35 limits being displayed at the location on the screen where
the indicia corresponding to said parameter was displayed
prior to the touching of said indicia.

providing a touch screen interface;

touching the touch screen at a plurality of points to define points on a parameter versus time curve;

selecting one of said ~~bars~~ for alteration;

15 touching the screen at first or second locations to increase or decrease, respectively, the displayed numeric parameter and thereby alter the value of the parameter to which the selected bar corresponds;

storing data corresponding to the bars in a

presenting on the screen a first series of bars

displaying on the screen a second series of bars

permitting only bars of the second series to be

6. The method of claim 5 in which the process control system is a dialysis machine.

7. The method of claim 6 in which the time
5 varying parameter is ultrafiltration, and in which the
method further includes displaying on the screen a numeric
parameter corresponding to an area under the parameter
versus time curve, said area representing the total
ultrafiltrate programmed to be removed from a patient.

8. A method of operating a dialysis machine to establish desired treatment parameters, the method comprising the steps:

15 providing first and second data card interface devices, the first device being associated with a computer, the second device being associated with the dialysis machine;

operating the computer in conjunction with the first data card interface device to load into a data card a set of desired treatment parameters, said set including parameters relating to three or more of the following:

ultrafiltration profile;

sodium profile;

bicarbonate profile;

blood pump flow rate;

treatment time;

dialysate flow rate;

~~dialysate~~ temperature;

~~blood pressure measurement schedule;~~

~~blood pressure alarm limits; and~~

heparin prescription

operating the dialysis machine in conjunction with the second data card interface device to read from said data card said treatment parameters; and

for each of said parameters:

displaying on a display device associated with the dialysis machine said parameter;

querying, via the display device, whether the displayed parameter is correct and soliciting operator verification of same; and

5 establishing the displayed parameter as a treatment parameter only if the operator verifies said parameter.

9. A kidney dialysis machine comprising:

10 a dialyzer with a dialysate compartment, a blood compartment separated from the dialysate compartment by a dialysis membrane, a dialysate input, a dialysate output, a blood input, and a blood output;

15 means for preparing dialysate and means for circulating the dialysate through a dialysate circuit, the dialysate circuit including the dialysate compartment, the dialysate input and the dialysate output of the dialyzer;

20 means for effecting extracorporeal circulation of blood from a dialysis patient through a blood circuit, the blood circuit including the blood compartment, the blood input, and the blood output of the dialyzer; and

means for effecting a preselected net passage of liquid from the blood compartment through the dialysis membrane to the dialysate compartment.

25 10. A kidney dialysis machine as recited in claim 9 further comprising:

a bypass valve in the dialysate circuit for automatically shunting dialysate flow away from the dialysate compartment; and

30 a flow sensor in the dialysate circuit for sensing that no dialysate is flowing to the dialysate compartment from the kidney dialysis machine whenever the bypass valve is shunting dialysate flow away from the dialysate compartment.

35 11. A kidney dialysis machine as recited in claim 9 further comprising:

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a valve in the dialysate circuit adapted to automatically shunt dialysate away from the dialysate compartment; and

5 a flow sensor in the dialysate circuit for sensing that no net passage of liquid from the blood compartment to the dialysate compartment or from the dialysate compartment to the blood compartment occurs whenever said valve is shunting dialysate away from the dialysate compartment.

12. A kidney dialysis machine as recited in claim 9 wherein said means for effecting a preselected net passage of liquid from the blood compartment through the dialysis membrane to the dialysate compartment comprises means for delivering a first volume of dialysate to the dialysate compartment of the dialyzer, means for simultaneously removing a second volume of dialysate equal to the first volume from the dialysate compartment of the dialyzer, and an ultrafiltration flow meter situated in the dialysate circuit between said means for delivering the first volume and said means for delivering the second volume, the ultrafiltration flow meter operable to remove a preselected volume of liquid from the dialysate circuit between said means for delivering the first volume of dialysate and said means for removing a second volume of dialysate.

13. A kidney dialysis machine as recited in
claim 12 including;
30 means for creating a volumetrically closed
hydraulic loop in the dialysate circuit between said means
for delivering the first volume and means for removing the
second volume; and
pressure-monitoring means for monitoring
35 hydraulic pressure in the closed loop against pressure
alarm limits.

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20 21. A kidney dialysis machine as recited in
claim 20 further comprising first pressure equalizing
means coupled to the inlet of the flow equalizer for
equilibrating hydraulic pressures at the inlets of the
"pre-dialyzer" and "post-dialyzer" compartments and second
25 pressure equalizing means coupled to the outlet of the
flow equalizer for equilibrating hydraulic pressures at
the outlets of the "pre-dialyzer" and "post-dialyzer"
compartments.

35 23. A kidney dialysis machine as recited in claim 9 further comprising means for automatically turning on preselected machine functions after a preselected duration of a power-off condition.

25. A kidney dialysis machine as recited in claim 9 adapted to effect extracorporeal circulation of blood using a blood-line set having at least one drip chamber for containing a volume of blood up to a preselected level in the chamber, the machine further comprising a drip-chamber level adjuster including an automatically actuated valve having a first end coupled to the drip chamber and a second end coupled to a reversible positive-displacement pump, the pump and valve controllably actuatable to permit a machine operator to selectively raise and lower the level in the chamber.

30 27. A kidney dialysis machine as recited in claim 9 further comprising:
means for circulating dialysate through the dialysate circuit at a preselected flow rate;
a blood-leak detector in the dialysate circuit
35 located downstream of the dialysate compartment, the blood-leak detector including an LED for generating light for passing through the dialysate passing through the blood-leak detector, and a photodetector for receiving

